



The new name for PacTel

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June 21, 1994

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, DC 20554

RE: PR Docket 93-61, Automatic Vehicle Monitoring Systems

Dear Mr. Caton:

The attached letter dated June 21, 1994 was forwarded to Chairman Hundt, Commissioners Barrett, Quello, Ness and Chong of the Commission. Please associate this material with the above-referenced proceeding.

Two copies of this notice were submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's Rules.

Please stamp and return the provided copy to confirm your receipt. Please contact me at 202-293-4960 should you have any questions or require additional information concerning this matter.

Sincerely,


Kathleen Q. Abernathy

Attachments

June 21, 1994

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June 21, 1994

Ralph Haller
Chief, Private Radio Bureau
Room 5002
2025 M Street, N.W.
Washington, D.C. 20054

Re: PR Docket No. 93-61, Automatic Vehicle Monitoring Systems

Dear Mr. Haller:

Attached is a report prepared by AirTouch Teletrac on the company's actual experience with interference from Part 15 equipment. We believe this information will be useful in your deliberations in the above proceeding.

Teletrac has more than five years of experience testing and operating its wideband vehicle location system in the 902-928 MHz band. Our systems have been commercially operational in the following six major metropolitan areas: Los Angeles (3 1/2 years), Chicago and Detroit (3 years), Dallas and Miami (2 1/2 years), and Houston (2 years). We have **more than 35,000 subscriber units** in operation 24 hours a day, 365 days a year.

As is described more fully in the attached report, Teletrac has not experienced a single case of harmful interference from meter reading transponders, metropolitan area network devices, indoor video links, wireless security systems, wireless bar-code readers, or wireless portable computers. This is despite the fact that **more than 750,000 Part 15 devices** are estimated to be operating in its coverage areas. In fact, only two types of Part 15 equipment cause any real problems. They are field disturbance sensors used as anti-shoplifting sentries and long range video links and these two groups of devices have caused **only 47 instances of harmful interference** during the three years Teletrac has been operating. Furthermore, in all instances of harmful interference, Teletrac has been able to mutually resolve the problem with either the manufacturers or the service provider.

The attached information demonstrates that Teletrac's system has been properly designed to operate in the 902-928 MHz band and that concerns about the potential for interference have been overstated. It also demonstrates that the Part 15 community and Teletrac have been able to negotiate mutually agreed upon resolutions without requiring the user to discontinue use of the Part 15 device and without FCC involvement.

Please feel free to contact me if you have any questions regarding the study and the operation of our system.

Sincerely,

A handwritten signature in cursive script that reads "Kathleen Abernathy". The signature is written in dark ink and is positioned above the printed name.

Kathleen Q. Abernathy

cc: Chairman Hundt
Commissioner Quello
Commissioner Barrett
Commissioner Ness
Commissioner Chong

Experience with Part 15 Interference

Introduction.

There has been a great deal of discussion in this proceeding regarding the susceptibility of the Teletrac system (and LMS systems in general) to interference from Part 15 equipment that operates in the 902 to 928 MHz frequency band. Concerns have been expressed by manufacturers and major users of Part 15 equipment with regard to the potential for interference to LMS systems and the consequences of such interference to those parties. Many of these parties have no direct experience with Teletrac or other LMS systems and have based their concerns on supposition rather than the realities of co-existing with LMS systems.

Teletrac believes that a review of the actual experience it has had with harmful interference from Part 15 equipment will help to alleviate these concerns.¹ This experience is from several years of commercially operating an LMS system in six major metropolitan areas in conjunction with hundreds of thousands of fully operational Part 15 devices. This experience provides valuable real world data on interference that cannot be garnered from a limited set of laboratory or field tests even under the most well conceived circumstances.

Teletrac's Experience Base.

Teletrac has over 5 years of experience in testing and operating its LMS system in the 902 to 928 MHz frequency band in conjunction with Part 15 equipment. Teletrac systems have been commercially operating in six major metropolitan areas: Los Angeles for 3 1/2 years, Chicago and Detroit for 3 years, Dallas and Miami for 2 1/2 years, and Houston for 2 years. These systems cover urban and suburban areas where Teletrac estimates over 12% of the U.S. population lives and works (based on 1990 census data). This coverage is achieved with about 180 fixed site receiving stations that share the spectrum with hundreds of thousands of Part 15 devices.² Teletrac provides reliable and useful services for over 35,000 subscriber units 24 hours a day, 365 days a year.³ Many of Teletrac's customers (including utilities and retailers) use Part 15 equipment that operates in the 902 to 928 MHz frequency band in their daily operations without degradation to either Teletrac or the Part 15 equipment.

¹ Teletrac has proposed a minimum tolerance threshold to interference for LMS systems (Teletrac comments, February 1994). Under the proposal, interference could be considered harmful by an LMS operator only if the tolerance threshold is exceeded. Teletrac is actively working with other LMS operators to arrive at an agreed upon level for this threshold.

² A detailed estimate of the number of Part 15 devices that are operating in Teletrac coverage areas is provided later in this document.

³ Interference to LMS receive sites depends on the number of sites, the number of Part 15 devices and the area of coverage and does not depend on the number of LMS subscriber units. Therefore, subscriber unit growth will not increase the incidence of interference.

Summary of Part 15 Interference to Teletrac.

Since starting commercial operations in 1991, Teletrac has experienced harmful interference from about 0.006% of the more than 750,000 Part 15 devices estimated to be operating in its coverage areas.⁴ Of the dozens of applications for Part 15 equipment, only two types of equipment have caused all but two cases of harmful interference.⁵ These primary causes have been field disturbance sensors used as anti-shoplifting sentries that operate under Part 15.245 and long range video links that operate under Part 15.249. Even within these two applications, only about 47 individual devices have caused harmful interference to Teletrac during the 2 to 3 1/2 years of operation in its 6 markets. These have consisted of about 30 field disturbance sensors and 17 long range point-to-point video links.⁶

Teletrac has not experienced a single case of harmful interference from meter reading transponders, metropolitan area network devices, indoor video links, wireless security systems, wireless bar-code readers, or wireless portable computers. Teletrac has seen harmful interference from the equipment of only 5 manufacturers out of the dozens of Part 15 manufacturers that have participated in this proceeding. On average, the rate of harmful interference encountered by Teletrac represents about 1 case every 4 months for each of its 6 cities. In the past 6 months Teletrac has experienced a total of only 6 cases.

Every case of harmful interference to date has been resolved cooperatively between Teletrac and Part 15 manufacturers or users and in no case has there been a need for FCC intervention nor has any Part 15 device been required to cease operation. Interference has typically been resolved by changing the operating frequency of the Part 15 device for about \$200 including parts and labor which Teletrac has paid in almost every case. In no case did a Part 15 user ever have to cease operation of equipment for longer than the time required to change the equipment to another frequency (typically on the order of 15 to 30 minutes). Given the limited number of units that have had to shift frequency there has been virtually no impact to other users of the band. Many, if not most, Part 15 devices have a selectable operating frequency to mitigate the potential for interference between each other and other users of the spectrum: some do this automatically while others require manual selection.

Teletrac's experience shows that co-existence with LMS requires no more than this existing capability on the part of Part 15 manufacturers and it is only in very limited cases (0.006%) that it becomes necessary. In those cases where frequency selection is not a designed-in

⁴ Teletrac has based its analysis on its own experience with Part 15 interference and the available data from Part 15 manufacturers on the number of devices operating in the 902 to 928 MHz frequency band.

⁵ The other two cases of harmful interference were caused by a cordless telephone and a long range point-to-point data link, both operating under Part 15.247. In both cases, the users were able to continue operating at frequencies outside of Teletrac's operating band.

⁶ In the case of one manufacturer of field disturbance sensors, an agreement was reached between Teletrac and the manufacturer whereby the manufacturer agreed to move devices at Teletrac's request at a negotiated cost to Teletrac. Teletrac field operations personnel took advantage of this agreement within their budgetary limits to migrate devices that caused even moderate levels of interference. The number of field disturbance sensors shown (about 20% of the total) represents those that caused interference in excess of the proposed level. Given the limited number of cases and the low costs involved, Teletrac plans to continue this activity.

capability, only very simple and inexpensive modifications to the equipment are necessary (typically replacement of a crystal oscillator costing several dollars).

Teletrac's experience provides a high degree of confidence that it can continue to co-exist with Part 15 equipment without risk of significant interference. Teletrac has designed its system with the realities of this spectrum in mind as is demonstrated by its reliability and performance over the years. Based on Teletrac's experience, it is clear that the preponderance of interference from Part 15 equipment is tolerable and will continue to be so. Through cooperation between Teletrac and Part 15 manufacturers, cases of harmful interference have been and can continue to be resolved easily and effectively, without FCC involvement and at no cost to the user.

Teletrac has not observed any trend that indicates the rate of occurrence has been increasing over time. If anything, the rate has decreased over the years. Those companies that have worked with Teletrac to resolve interference have endeavored to minimize the potential for further interference when they deploy new equipment. Teletrac has also seen a trend for the devices used in long range video applications to migrate to the 2.4 GHz frequency band and expects the number of cases of harmful interference from these to decline in the future.

Magnitude of Part 15 Interference.

The magnitude of Part 15 interference to Teletrac over the past 3 1/2 years can be assessed by comparing the number of cases of harmful interference to the number of Part 15 devices operating in the frequency band in areas covered by Teletrac systems. To estimate this number, the total number of devices in use nation-wide is scaled by the proportion of the population that Teletrac covers. This should be a somewhat conservative estimate given that Part 15 devices are heavily deployed in metropolitan areas such as those covered by Teletrac systems.

Total U.S. Population of Part 15 Devices.

Estimates of the number of Part 15 devices operating nation-wide in the 902 to 928 MHz frequency band are shown in Table 1. These estimates have been taken either directly from Part 15 manufacturer figures or from the National Telecommunications and Information Administration (NTIA) based on data from manufacturers. The overall estimate is probably low given that many of the estimates are more than a year old and they come from a partial list of Part 15 manufacturers.

Part 15 Population within Teletrac Coverage Areas.

Teletrac covers over 12% of the U.S. population in its 6 commercially operating systems. Table 2 shows the number of Part 15 devices Teletrac estimates are operating within its coverage areas which assumes the devices are approximately deployed in proportion to the U.S. population.

Table 1. Estimated Number of Part 15 Devices in 902 to 928 MHz Band.

Equipment / Use	Quantity	Source
Spread Spectrum	106,500	NTIA "Preliminary Report on Spectrum Reallocation", February 1994.*
Wireless Stereo/Video	300,000	NTIA "Preliminary Report on Spectrum Reallocation", February 1994.*
Cordless Telephone	1,500,000	NTIA "Preliminary Report on Spectrum Reallocation", February 1994.*
Wireless Security Alarms - Residential	144,000	NTIA "Preliminary Report on Spectrum Reallocation", February 1994.*
Wireless Security Alarms - Commercial	82,500	NTIA "Preliminary Report on Spectrum Reallocation", February 1994.*
Field Disturbance Sensors	30,000	FCC "Memorandum, Opinion and Order", GEN docket 87-389, June 12, 1990.**
Wireless Bar-code Readers and Portable Computers	1,000,000	PR Docket 93-61, Comments of the National Retail Federation, Feb 25, 1994.***
Meter Reading Transponders	3,000,000	PR Docket 93-61, Comments of Itron, Inc. March 15, 1994.**
TOTAL	6,163,000	

* These are estimates as of mid-1993 and therefore the actual number of devices in operation today is probably much larger.

** The actual number is probably much larger since this represents the number of devices from only one manufacturer.

*** This reference states that "millions" of these devices are in operation so 1 million is used here with the understanding that the actual number may be several times larger.

Table 2. Estimated Number of Part 15 Devices in Teletrac Coverage Areas.

City	Estimated U.S. Population Covered by Teletrac Systems	Estimated Number of Part 15 Devices in Coverage Area
Chicago	2.2%	135,586
Dallas	1.4%	86,282
Detroit	1.3%	80,120
Houston	1.2%	73,956
Los Angeles	4.8%	295,824
Miami	1.4%	86,282
Total	12.3%	758,050

Incidence of Harmful Interference.

Based on the large number of Part 15 devices estimated to be operating in the areas covered by Teletrac and the few cases of harmful interference that have actually been observed, the rate of occurrence of harmful interference has been about 1 in 15,000. Each case shown in Table 3 represents an individual Part 15 device which, due to its deployment and/or proximity to a Teletrac receive site, has caused degradation in system performance. This harmful interference has resulted in reduced coverage and/or reduced location accuracy for signals received by the affected site. In each case, the interference has been resolved cooperatively by Teletrac and the Part 15 manufacturer (or in a very few cases, the user). In almost all cases the interference has been resolved by changing the operating frequency of the Part 15 device with Teletrac paying the cost.

Table 3. Incidence of Harmful Interference from Part 15 Devices.

Equipment Type / Use	Part 15 Devices in Teletrac Coverage (a)	Total Cases of Interference (b)	Active Cases of Interference (c)	Cases of Interference Involving FCC (d)
Spread Spectrum	13,100	1	0	0
Wireless Stereo/Video	36,900	17	2	0
Cordless Telephones	184,500	1	0	0
Wireless Security Alarms - Residential	17,712	0	0	0
Wireless Security Alarms - Commercial	10,148	0	0	0
Field Disturbance Sensors	3,690	30	0	0
Wireless Bar-code Readers and Portable Computers	123,000	0	0	0
Meter Reading Transponders	369,000	0	0	0
Total	758,050	49	2	0
Percent	100%	0.006%	0.0003%	0.0%

Definitions: (a) = (Total number of devices in U.S.) * (Percent of US Population covered by Teletrac)
 (b) = Total number of Harmful Interference cases in all Teletrac coverage areas.
 (c) = Total number of Harmful Interference cases awaiting resolution today.
 (d) = Total number of Harmful Interference cases referred to FCC for resolution.

In no case has a user been required to discontinue use of a device other than for the time required to make the necessary modifications or adjustments to the equipment. In most cases this is an adjustment or modification that can be completed in a few minutes at the customer's premises by the manufacturer or a qualified technician. In some cases it is accomplished through a user selectable frequency option. As shown in Table 3, no case of harmful interference experienced to date has required FCC intervention or involvement.

Typical Part 15 Signals that Cause Harmful Interference.

The incidence of harmful interference encountered by Teletrac has been almost entirely due to industrial or commercial uses of Part 15 equipment. The harmful interference that has occurred has been caused almost exclusively by two types of equipment:

- long-range point-to-point video links
- Field disturbance sensors

The signals from equipment used in these applications can be harmful to LMS receivers under limited circumstances for two principal reasons: they either transmit continuous signals (narrowband or wideband) and/or they transmit from antennas placed at relatively high elevations. However, it should be noted that even these particular devices have only been harmful when deployed in close proximity to a Teletrac receiver, at relatively high antenna elevations, or when directional antennas are directed toward receive sites. From the data presented it is clear that there are minimal adverse impacts on the vast majority of Part 15 users and developers from Teletrac's LMS operations.

Process Used for Resolving Harmful Interference.

When Teletrac determines that there is harmful interference occurring at a particular receiver, it first attempts to identify the nature of the signal; such as its frequency, bandwidth, duty cycle, power level, etc. Next, it determines the source of the interference using direction finding techniques to "zero in" on the transmitting device. If enough information is available at this point from the signal characteristics and visual observation of the device, Teletrac contacts the manufacturer. If the device cannot be precisely identified, then the user is contacted to determine what device is being used (make and model) so that the manufacturer can be contacted. Teletrac then contacts the manufacturer to reach agreement on how to resolve the interference.

In almost all cases to date, a mutually agreed upon resolution has easily been reached with Teletrac paying the manufacturer or a representative for the expense of resolving the interference. In the case of one manufacturer of field disturbance sensors, Teletrac has established an agreed upon rate for labor and material and simply provides the Part 15 manufacturer with a field service request when an interfering device is identified. Teletrac is then billed by the manufacturer for the costs incurred. In most other cases, the means for resolving the interference and the reimbursement of costs are negotiated on a case-by-case basis. The costs are typically between \$150 to \$250 per incident (or device). In a few cases the Part 15 manufacturer has agreed to resolve the problem on its own without any payment from Teletrac. In exceptional cases, Teletrac has replaced the device for the user with a comparable device operating on a different frequency.

Conclusion.

The information presented shows that LMS systems can co-exist in the 902 to 928 MHz frequency band with Part 15 devices. The limited cases of interference that Teletrac has experienced over the years of commercially operating its system in six major metropolitan areas provides a clear picture of how small the potential for harmful interference really is.

The types of Part 15 devices that have caused harmful interference have been primarily limited to two applications (anti-shoplifting and long range point-to-point links) and within these applications to only a small fraction of the units deployed. There has been only one case of interference observed from a consumer device with the remaining cases all being caused by industrial/commercial devices that either continuously transmit their signals and/or are in close proximity to Teletrac receive sites at high antenna elevations. The total number of incidents of harmful interference encountered by Teletrac over the past 3 1/2 years represent about 0.006% of the installed base of Part 15 equipment that operate in its coverage areas. In light of these statistics it is clear that the concerns expressed by the commenters in the LMS proceeding have been based on an overstated potential for interference. It is also clear that the tolerance of the Teletrac system and its receivers to interference have been underestimated.

Based on the data presented, Teletrac has shown that its system has been properly designed to operate in the 902 to 928 MHz frequency band. It has also shown that Part 15 manufacturers may continue to develop equipment for this band without fear of massive, or even noticeable, disruption due to LMS operations. Therefore the FCC should ensure that Teletrac can continue to operate its systems under permanent LMS rules.